CHAPTER 6

WATERSHED MANAGEMENT

BMP 6-1
CRITICAL AREA PROTECTION

DEFINITION

Protection of critical erosion areas from damaging use by grazing animals, people and vehicular traffic.

PURPOSE

To manage the land use of critical erosion areas in a manner which reduces wind and water erosion and improves the quality of surface runoff waters.

APPLICABILITY

Protection of critical areas is applicable to road cut and fill slopes, dams, borrow pits, development or construction sites, drainage ways, stream channels, mined areas, mine and mill wastes, burned range and forest lands or other surface disturbance areas.

PLANNING CRITERIA

Evaluate the site specific conditions, drainage and potential erosion hazards of the target area and the revegetation requirements. Determine if temporary or permanent protection is needed to achieve a stabilized site. Most steep slopes, fragile soil areas and mine wastes that contain toxic materials may require long term (multiple years) protection. Other areas such as rangeland burns or construction sites may need protection only until vegetation is well established. Revisions to land use plans and ordinances may also be necessary to further protect critical areas and to avoid a repeat of the situation.

METHODS AND MATERIALS

1. Control access to the project area by fencing or other means of restricting access. (See Fencing guidelines and specifications in Appendix G-6.)

2. For large areas such as rangeland burns, fencing may not be required if the area can be protected by deferred grazing or animal control until the vegetation is well established. Electric fences can be used where only temporary protection is needed.

3. Construct surface water diversions where needed to direct runoff water around the site.

4. **Determine with the assistance of qualified professionals, the necessary steps to stabilize and reclaim the disturbance area**.

MAINTENANCE

Periodically inspect and repair fences or barriers as needed to maintain functionability. Review land use management strategies and revise as necessary. On grazable sites, evaluate grazing use during the grazing season. Manage land use activities to maintain adequate plant cover for soil protection.

EFFECTIVENESS

Protecting critical areas from overuse by grazing animals, people and vehicular traffic will aid revegetation and stabilization of these areas and will result in reduced erosion and sediment delivery.

BMP 6-2
CRITICAL AREA STABILIZATION

DEFINITION

Development of a plan of action to stabilize critical erosion sites. This includes natural sites as well as those created by man's activities.

PURPOSE

To stabilize and reclaim the surface disturbance area, reduce soil erosion, and control runoff and sediment delivery from critical erosion sites.

APPLICABILITY

On surface disturbance areas where soil and vegetation has been disturbed by activities such as housing, industrial developments, roads, highways, pipelines, powerlines, dams, oil, gas, and geothermal exploration, mining, recreation, wildfires, and animal overgrazing. Stabilization treatments are applicable for all topographical, elevational and climatic situations encountered.

PLANNING CRITERIA

1. Soils - It is essential to know the types of soils that exist on the project site and the characteristics of these soils that will affect construction and erosion control treatments. **Soils information may be obtained from published soil surveys, from conservation district offices or may have to be gathered in the field by qualified professionals**.

2. Surface drainage and topography - Base maps of the project area should be developed at sufficient detail to address the site specifics of the area. A comprehensive drainage plan and sediment/erosion control plan should be developed. All the necessary components should be designed and specified by a qualified engineer.

3. Vegetation - The natural vegetation should be protected and maintained wherever possible. Surface disturbances should be coordinated with the construction schedule and only the surface area that is essential for completion of the project should be disturbed. Plans for revegetating the disturbance areas should be included.

4. Slope Gradients - Cuts and fills should be minimized and slopes reduced to the extent possible given the specifics of the site. Available soil survey information and reports for soil stability characteristics should be utilized in the project design. Where it is not feasible to flatten slopes to the desired grade, it may be necessary to use structural measures such as retaining walls.

METHODS AND MATERIALS

There are numerous sediment and erosion control structures and treatments which may be required given the specifics of the site. The majority of these are referenced in other sections of this handbook. **It should be emphasized that a qualified professional should be consulted regarding design and construction requirements (See Appendix A-2)**.

MAINTENANCE

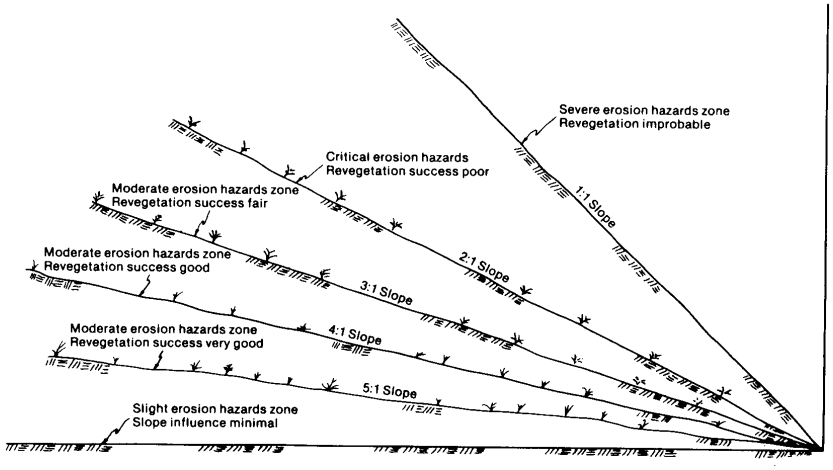
Structural measures are to be maintained in a condition to adequately perform their designed function. Vegetation should be replanted on areas where initial plantings fail to establish.

Fertilize and irrigate vegetation as needed if these treatments are included in the plan. Continue to protect the area from grazing animals, pedestrians, vehicle traffic and fire.

EFFECTIVENESS

Proper installation and maintenance of critical area stabilization is a highly effective method for reducing unnatural sediment loads in runoff waters from these sites and in reducing total runoff.

FIGURE 6-1 (BMP 1)
EROSION HAZARD ZONE



BMP 6-3
STREAM PROTECTION & STABILIZATION

DEFINITION

Structural and vegetative treatments to stabilize stream channels and streambanks.

PURPOSE

To reduce erosion and sediment loads, improve fish and wildlife habitat, maintain channel capacity, and prevent damage to land, utilities, roads, buildings or other facilities adjacent to the stream.

APPLICABILITY

Applies to natural streams or excavated channels where stream channels and/or streambanks are experiencing erosion.

PLANNING CRITERIA

Streambank Protection - Each reach of a stream is unique, so streambank protection measures must be installed according to a plan adapted to the specific site. Hydrology of the entire stream above and below the site must also be considered. Streambank protection will generally require a combination of vegetation and sediment and/or erosion control structures.

1. Streambank protection should start and end at stabilized or controlled areas within the stream. Treatments are planned and implemented based upon a comprehensive analysis of the entire stream.

2. Channel clearing to remove debris, stumps and fallen trees is often the initial required treatment but must be done in a coordinated manner with considerations for the other resources. In most instances only loose debris should be cleared and debris that is cemented into place should be left. Branches, trunks, etc. sticking out of the sediment can be cut off, thus removing the obstruction without disturbing the sediment and/or stream banks. Preservation of fisheries and their associated habitat is a priority.

3. Bank sloping is sometimes needed to reduce the slope and provide suitable conditions for the installation of structures and revegetation. Before bank sloping is initiated consideration for impacts to fisheries and their associated habitat must be analyzed.

4. The channel grade must be stabilized by natural or artificial means before permanent bank protection can be successfully installed.

5. Changes in channel alignment should be made only after a thorough evaluation of the effect of the change on land use, hydraulic characteristics and existing structures and facilities.

6. Structural measures must be designed to withstand floods without serious damage, maintain functionability while aesthetics are incorporated.

7. Protect existing vegetation and revegetate disturbed areas. Natural revegetation, depending upon the specifics of the site, can provide stable channels while preserving both wildlife and fisheries habitat. Control the use of herbicides near streambanks.

Stream Channel Stabilization - Channels may aggrade or degrade during a given storm or over a short period of time. A channel can be considered stable if the channel bottom remains at essentially the same elevation over an extended time. Consideration should be given to the following points:

1. Character of materials (i.e. rock, soils, etc.) that comprise the stream bottom.

2. The quantity and characteristics of sediments entering the channel or that have the potential to enter the channel. A comprehensive analysis should be conducted based upon present conditions and potential changes which may result from changes in land use, surface treatments, upstream improvements and structural measures.

3. A comprehensive watershed hydrological analysis including peak stream flow, flow velocities and volumes at various frequencies.

4. Effects of installation of grade control structures.

5. Measures and construction methods that improve fish and wildlife habitat to the extent needed and practical.

6. Structural design and installation to meet approved engineering standards. Structures must be designed specifically for the site.

7. Construction carried out in a manner that will create the least disturbance to existing vegetation. Surface disturbance areas should be revegetated.

METHODS AND MATERIALS

The following are utilized to stabilize stream channels and are usually designed to function together. The goal of stream protection and stabilization is to recreate the naturally stable channel conditions which includes an appropriate shape, pattern and gradient for the materials, watershed and land form. **A qualified professional should be consulted regarding proper design and construction of stream stabilization treatments**.

1. Grade Stabilization Structures - Installed to stabilize the grade and control channel erosion.

2. Riprap - Placed or dumped heavy stone to provide protection for the streambank (See BMP 4-3, Chapter 4-pg 4-8).

3. Revetments - Pervious or impervious structures built on a parallel to the stream at the base of the streambank to prevent bank erosion. These structures prevent scouring resulting from high streamflow velocities.

4. Jetties - Deflectors constructed of posts, piling, fencing, rock, brush or other materials which project into the stream to protect the streambank on curves and other reaches subject to high velocity flows. Utilization of wood or brush should be followed with permanent vegetation as wood will decompose.

5. Fencing - Fencing is often needed to protect streambanks from damage by grazing animals and vehicular traffic.

6. Revegetation - Planting streambanks and surface disturbances within the stream channel with native and/or adapted plant species. See Appendix E-2 for guidelines and specifications for streambank plantings.

MAINTENANCE

Maintain all structures and fences so they adequately perform the function intended. Protect streambanks from overuse by grazing animals, vehicles and people.

EFFECTIVENESS

Stabilization of stream channels and streambanks is an effective treatment to reduce sediment loading, control erosion and land damage. Great care needs to be taken when using engineered structures so that these structures do not aggravate the situation. For example in flat alluvial settings, streams naturally meander and change courses. Trying to keep such a stream channel in one particular location may be futile and counter productive.

BMP 6-4
FLOODWATER RETARDING STRUCTURE

DEFINITION

A single-purpose structure providing for the temporary storage and controlled release of floodwater.

PURPOSE

Floodwater retarding structures are installed to reduce flood damages downstream by controlling the release rate from flood flows of predetermined frequencies. They protect the watershed and may also permit the use of more economical channel improvements or stabilizing structures in the channel downstream.

APPLICABILITY

The construction of a floodwater retarding structure requires qualified professional engineering and natural resource expertise. A site may be considered for a structure if it meets all of the following minimum conditions:

1. The construction of the floodwater retarding structure is permitted by applicable state statutes and regulations.

2. Topographic, geologic and soil conditions at the proposed site are satisfactory for the development of a feasible dam and reservoir.

3. **The sediment yield at the site is not excessive as determined by a qualified professional engineer**.

PLANNING CRITERIA

Floodwater retarding structures must be fully investigated, designed and installed by qualified professional engineers. **Plans, designs and installations must consider water rights and meet the requirements of the laws of the State of Nevada and be cleared by the state engineer**. An environmental analysis should be conducted which identifies all potential impacts to existing natural resources (i.e. fisheries, wildlife, vegetation, etc.). Long term considerations should identify impacts associated with downstream degradation from sediment starvation, upstream aggradation from raising the base level of the stream and other related impacts.

MAINTENANCE

A comprehensive inspection and maintenance plan should be developed to insure functionablity of the structure for the design life. Periodic inspection is necessary to assure that the structure has not developed any problems and to determine if the sedimentation rate is in keeping with initial estimates. If a problem is identified, appropriate remedial measures should be undertaken.

EFFECTIVENESS

Floodwater retarding structures are effective in regulating floodwater runoff if they are designed, installed and maintained properly. A reduction in flood damage and sediment delivery can be expected from floodwater retarding structures.

BMP 6-5
FLOODWATER DIVERSION

DEFINITION

A channel with a supporting embankment or dike constructed on the down slope side which will divert floodwaters from one area to another.

PURPOSE

This treatment will divert floodwater from lowland areas or from specific areas within the floodplain requiring protection. Floodwater diversions will protect the land, surface improvements and the watershed by reducing erosion and sediment delivery to receiving waters.

APPLICABILITY

This practice is applicable where:

1. Floodwater which originates up gradient from the lowland area to be protected and is causing, or has the potential to, damage agricultural land, crops or other land uses.

2. An adequate outlet for the design flow is available, either by gravity flow or by pumping. The outlet should be suitable for the quality and quantity of water and sediment to be disposed of, and consideration should be given to possible damages above or below the point of discharge. The outlet may be a floodway or natural channel, river or lake.

3. Lands to be protected are suitable for the planned use within their capabilities after installation of required conservation practices.

This practice does not include dams constructed to divert floodwaters to a waterspreading system, irrigation canal or storage facility for beneficial use. A Diversion Dam may discharge in a Floodwater Diversion.

PLANNING CRITERIA

The design and installation of floodwater diversions should be under the supervision of a qualified professional engineer.

Location - The floodwater diversion should be located to protect the maximum area of lowland, consistent with economic limitations, topographic requirements, and the desired slope of the hydraulic gradeline. These structures must meet applicable federal, state and local laws.

Hydraulic Gradeline - The hydraulic gradeline of the floodwater diversion should tie into the elevation of water in the outlet expected for the frequency storm selected for design and should be established with due regard for damages which may occur on the opposite side of the floodwater diversion from the supporting embankment. It should have a slope in the direction of flow which will result in a velocity that will not cause excessive erosion or sedimentation.

Velocity - The maximum permissible design velocity should be based on site conditions. A desirable minimum velocity is 1 1/2 feet per second. On flat grades where the design velocity is below this value, the cross section should be adjusted to obtain the most efficient section that depth and maintenance methods permit. Consideration must be given to the increased shear stress in channels carrying water that would have dissipated energy over a floodplain.

Berm and Embankment - The minimum berm width between channel and embankment should be based on depth of channel. The embankment may be constructed from the channel excavation or from suitable borrow. The design height of the embankment should be the design water depth plus a freeboard of at least two feet. The constructed height should be the design height plus an allowance for settlement based on consideration of soil material and the anticipated compaction during construction.

METHODS AND MATERIALS

Floodwater Diversions should be designed and constructed by a qualified professional engineer. The following generally describes the installation process.

Site preparation - The entire width of the site for the floodwater diversion, including channel, berm, and embankment should be cleared of all trees, stumps, roots, brush, boulders and debris. All channel banks and sharp breaks should be sloped no steeper than 1:1 unless such sloping would likely result in changing a stable slope into an unstable slope. Topsoil which is high in organic matter should be removed. The ground surface where the embankment is to be placed should be thoroughly scarified before placement of the embankment material.

Excavation and Construction of Embankment - Excavation of the channel and placement of spoil in the embankment should progress simultaneously from the outlet upstream. The channel is excavated and the embankment constructed per the dimensions specified in the engineering plans.

Vegetative Cover - An adequate vegetative cover or non-vegetative slope stabilization BMP should be implemented on the embankment where it is necessary to protect against erosion by flood flows, wave action, or from rainfall and runoff on the embankment.

MAINTENANCE

Periodic inspection of the embankment is required, particularly after precipitation or storm events. Identified damage should be repaired immediately or the appropriate remedial measures taken as necessary.

EFFECTIVENESS

Floodwater Diversions are effective in diverting floodwater when they are designed, installed and maintained properly.

BMP 6-6
PRESCRIBED USE OF FIRE

DEFINITION

The prescribed use of fire is defined as the deliberate and planned use of fire in a controlled manner to achieve or accomplish specific natural resource management prescriptions.

PURPOSE

Prescribed fire is utilized in the following general natural resource management fields; silviculture, range management, watershed management, fire prevention and control, land clearing, pathological and entomological uses and wildlife management.

APPLICABILITY

This practice is applicable on sites which are compatible to the prescribed use of fire, where the benefits are larger than the risks associated with utilizing fire as a management tool, and within the auspices of an overall watershed or "holistic" resource conservation plan.

PLANNING CRITERIA

The design and utilization of prescribed fire requires the expertise of a multi-disciplinary natural resource team and a coordinated effort among federal, state and local agencies. **Under no circumstances is a layman to initiate or implement the prescribed use of fire. The Nevada Division of Forestry should be contacted prior to the development of any fire prescription.**

Fire can be used in a variety of situations throughout the watershed from improvement of the overall condition of a watershed to specific applications for vegetation manipulation. Fire is often the most efficient means of forest regeneration including seedbed preparation, opening of cones, reduction of vegetative competition and a fertilizing effect from mineral nutrients released in the ashes. Vegetation cover types and/or species composition can be changed or modified through the use of prescribed fire. Vegetation type manipulation must be based upon sound ecological knowledge of natural successional trends coordinated with other watershed, resource and land use goals.

Vegetation type and cover manipulation can result in economic benefits such as: improved forage for livestock, more valuable commercial timber stands, retained naturalness where historic fire prevention is changing vegetation, prevention of less frequent but more damaging catastrophic wildfires, improved wildlife habitat in support of public hunting and in controlling certain insects and/or diseases. Prescribed fire can also be utilized in certain specific situations to improve the overall surface stability of a watershed resulting in reduced soil erosion and improved water quality.

METHODS AND MATERIALS

As stated above, the design and utilization of prescribed fire requires the expertise of a multi-disciplinary natural resource team and a coordinated effort among federal, state and local agencies. A variety of federal, state and local permits may be required including a comprehensive environmental impact analysis. **Any prescribed use of fire in Nevada requires approval from the Nevada Division of Forestry among others.** Site specific data gathering activities would potentially include, soils information, surface and ground water resources, vegetation, topography, climate, existing and proposed land uses wildlife and fisheries and other related information.

Primary components of a fire prescription include:

1. Baseline data gathering and inventorying of the watershed.
2. Development of a comprehensive watershed plan in a coordinated manner with all effected entities.
3. Conducting an environmental analysis of the watershed plan.
4. Upon approval to initiate a prescription the following activities are necessary.

    - Area and boundary selection
    - Firebreaks and fire control
    - Sediment and erosion controls
    - Defining the prescription window, or set of weather, fuel loading and fuel moisture conditions
    - Preparation of fuel
    - Burning plan
    - Fire crews, equipment, communications & support
    - Weather information during burn period
    - Burn execution
    - Follow-up, monitoring and analysis.

MAINTENANCE

Regular inspection, monitoring and maintenance is critical to the success or failure of a prescribed burn, particularly after precipitation or storm events. Identified damage or concerns should be addressed immediately and appropriate remedial measures taken as necessary.

EFFECTIVENESS

The prescribed use of fire has proven effective under specific natural resource management situations. When properly planned, designed, implemented and followed up, prescribed fire is an effective watershed management tool which can, in some situations, reduce long term erosion and sediment transport.